# The Great Sediment Settlement Race

## OBJECTIVES

1. Students will be introduced to geology, weathering processes and how the size of sediments are related to the processes of erosion and deposition.

2. Students determine how sediment size relates to turbidity and settlement time in water.

3. Students discuss sediment types found in estuarine environments.

**GRADE LEVEL**: 5th – 9th

**TIME**: variable, minimum 20 – 30 minutes

**MATERIALS**:
Sediment size chart photocopies (1 per group)
Sediment sizes – muddy water, fine sand, coarse sand, and pebbles (1/4 cup each per group)
4 Metrics ruler showing millimeters (1 per group)
4 clear plastic cylinders per group (2L soda bottle with the tops cut off will work)
4 stop watches per group
paper and pencil – each student
4 magnifiers (per group)

## BACKGROUND INFORMATION

Physical and chemical erosion processes in our natural environment cause rocks and minerals to break down. They may chemically change from one material to another such as the mineral potassium feldspar altering to kaolinite clay. Rocks and minerals may also break down physically into smaller and smaller pieces. An example could be a large piece of quartz breaking slowly over geologic time into very small grains found in quartz sand. Such actions of wind, rain, currents, ice, waves, and gravity slowly break things into particle sizes easily transported by water currents.

These physical and chemical processes happen over hours and days to thousands and millions of years. They slowly break down our mountains and transport them to our rivers and estuaries. Sediment erosion, transport, and deposition are natural processes that never stop. Sediment is the foundation of many different ecosystems. Sediments moving into a marine setting (Gulf or Ocean) may be shifted constantly through currents and wave action. There are many different types of soils in every county, state, and country around the world. They create unique settings for plants and animals to grow. The soils found in wetlands and estuaries are important.

Sediment and soils do a variety of things. These include a place for plants and animals to grow, materials for construction, filter for water and waste, and decomposing materials. We are going to focus on how sediment is transported by water. How does sediment get to its present location? How fast water moves determines how large a particle will be carried, whether it will be deposited, and even if it stays in suspension.

Erosion and sedimentation are management issues that face many communities near estuarine environments. While these are natural processes, they are often accelerated by activities of man. Shoreline development, clearing vegetation from streambanks, and filling sediment at construction sites can contribute to increases in the sediment cycle. As these materials reach the estuary, they often

cover submerged vegetation, choke marine life, and decimate reef populations. Because the sediment feed is faster than normal earth processes, flora and fauna are unable to compensate. After a storm, you may notice that the water in streams and bays is cloudy or **turbid**. Turbidity is caused from sediments that are suspended in the water column. Some turbidity is natural, but too much can mean trouble for aquatic organisms.

Sediment Cycle

Rock or Mineral goes through physical and / or chemical **weathering** processes
Smaller particles are **transported** by wind, ice, or water
**Deposition** occurs as the mode of transport is altered
Transportation can begin again if transport is started

Gravity allows water to flow downhill creating a current. As the current moves, depending on the slope of the land, the velocity of the water will move faster or slower. The faster the velocity, the larger the sediment size that can be rolled or bounced along the bottom, moved short distances, dissolved, or held in suspension in the water column. Other factors can also play a roll in how sediment is transported and deposited. Estuaries are often good collection areas for fine sediments that have traveled long distances. Vegetation often traps these fine sands, silts, and clays. Combined with decaying organic matter, these sediments help create a prime home to many plant and animal species. We'll focus on simple mechanism of sediments settling in water.

Classroom Terms
Erosion
Sedimentation
Slope
Velocity
Turbidity

## ADVANCED PREPARATION

1. Obtain sediment sizes for your class. Sand and pebbles can be purchased in large quantities at any home improvement store (Home Depot, Lowes, Wal-Mart, etc). You may want to collect some of these materials outdoors yourself from a local stream or beach. If you have sieves you can sort soils / sediments with your students in class. Make sure the materials are clean. For an accurate race, have four different sediment sizes:
    a. Pebble
    b. Coarse Sand
    c. Fine Sand
    d. Muddy Water

2. Obtain four clear containers that you can see through for your race for each group. If you want more than one team, you can double the number of containers. These can be clear plastic PVC capped at one end, graduated cylinders from a chemistry lab, or clear soda bottles with the top opening cut out.

3. Obtain four measuring cups or similar container to hold sediment sizes. If more than one team double the number of containers. These should be clean of other materials.
4. Obtain fresh water (tap will do), enough to fill your clear containers 3/4 to the top, leaving room for adding the sediment.

5. Make sure you have stop watches, a clock, or other means of timing your experiment. You will need something that reads seconds.

6. Inform students that they will need paper and pencil to record their times and observations. You may wish to copy the exercise page provided with this activity.

7. Have rulers (metrics) and magnifying glasses to record sediment sizes.

8. Inform students that they will need paper and pencil to record their times and observations. You may wish to copy the exercise page provided with this activity.

## PROCEDURE

1. Divide students into groups of 4 (8 is possible – 2 students per sediment size).

2. Have each group get four clear containers, water, and ¼ cup of each sediment size.

3. Have each group fill their containers 3/4 of the way to the top of their container with water.

4. Have each group measure and record the *average* particle size of each sediment type. They will use their metric scale ruler and magnifier to see the smaller sizes. The clay will not be big enough for them to see so give them a number from the size chart provided.

5. Watching their stop watches, have all students pour their sediment type into their containers at the same time. Start the stop watch simultaneously. Teams of eight, one student pours and one student times.

6. The students record the seconds that it takes for their size to settle to the bottom of the container. They should settle in this order 1) pebble, 2) coarse sand 3) coarse silt, and 4) muddy water (which may stay suspended for days).

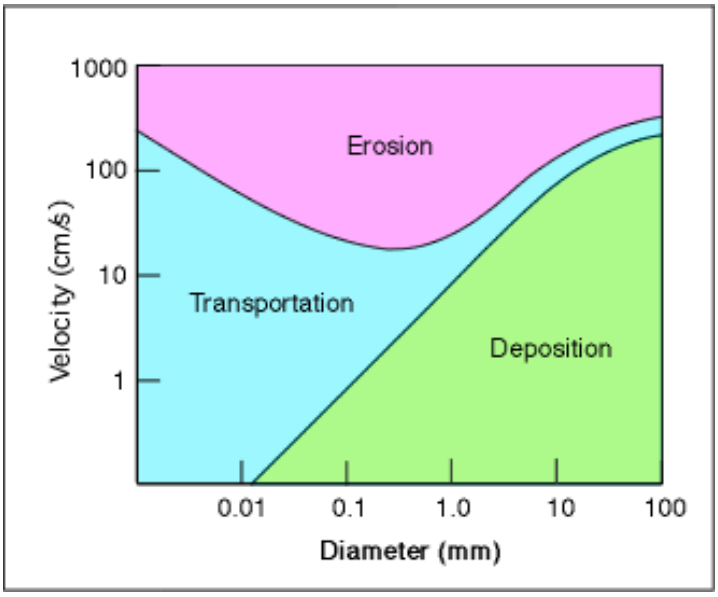
7. Have all students report their settling rates. Discuss what this may mean for sediments in estuaries.

<u>Extensions</u>

1. Continuously stir the containers upon pouring in the sediments. Compare the time to settle versus the still water from the first experiment.

2. After pouring the sediments into the containers, stir the water in the containers. Pay careful attention to not touch the sediments on the bottom. See which sizes are re-suspended in the water.

Sediment Particle compared to Water Velocity = Hjulstrom Diagram




| Name of Particle | Size Range | Loose Sediment Type |
|---|---|---|
| Boulder | >256 mm | Gravel |
| Cobble | 64 - 256 mm | Gravel |
| Pebble | 2 - 64 mm | Gravel |
| Sand | 1/16 - 2mm | Sand |
| Silt | 1/256 - 1/16 mm | Silt |
| Clay | <1/256 mm | Clay, mud |

## RESOURCES

Understand Earth, 4th edition, 2003, Press, Siever, Grotzinger, and Jordan, Freeman Press.

Any introductory geology text book which includes sediments and sedimentary processes could be useful.

## WEBSITES

Mobile Bay National Estuary Program http://www.mobilebaynep.com
University of South Alabama Earth Science Department http://www.southalabama.edu/geography
Weeks Bay Reserve Foundation http://www.weeksbay.org/index.htm
National Estuarine Research Reserve System http://nerrs.noaa.gov/WeeksBay/welcome.html

Geological Survey of Alabama http://www.gsa.state.al.us/
Discovery School, The Lesson Plan Library http://school.discovery.com/lessonplans/earthsci.html
U.S. Geological Survey, The Learning Web http://www.usgs.gov/education/
The Geological Society of America, http://www.geosociety.org/

Written By:

| | |
|---|---|
| Lee Yokel | Mobile Bay National Estuary Program |
| Margaret Sedlecky | Weeks Bay National Estuarine Research Reserve |